

In the Claims:

1. (currently amended) A method of holographic data storage ~~on a photosensitive~~  
with holographic data storage media which comprises the steps of:

recording one or more holograms representing ~~computer-readable~~ data at one or more locations on the media; and ~~after such recording exposing the media with sufficient energy to fix the media~~

providing optical energy from said recording of at least one of said one or more holograms to against further recording in said one or more locations on the media of one or more previously recorded holograms, while said recording of said at least one of said one or more holograms is being carried out, to fix the media against further recording at said one or more locations on the media where said optical energy is provided wherein said media is of photopolymer material.

2. (currently amended) The method according to Claim 1 wherein said holographic media has a dynamic range capable of recording ~~accepting a plurality multiplicity of~~ holograms representing data in at least one location on said media ~~holographic images~~, said recording step is carried out over a portion of said dynamic range, and said providing ~~exposing~~ step is carried out over the remainder of said dynamic range.

3. (currently amended) The method according to Claim 1 wherein said recording step provides a reference beam and an object beam which overlap each other in said media to record said at least one of said one or more holograms, and said reference beam has a portion non-overlapping said object beam, and said non-overlapping portion provides said optical energy to fix the media against further recording at said one or more locations of said previously recorded holograms ~~said exposing step provides exposure energy over an energy range greater than that used in said recording step.~~

4. (currently amended) The method according to Claim 1 wherein said providing ~~exposing~~ step is carried out using said optical energy which has an optical source ~~providing~~ optical wavelengths that the holographic media is photosensitive to.

5. (currently amended) The method according to Claim 1 wherein said providing exposing step is carried out using said optical energy which has an optical source containing wavelengths that the holographic media absorbs and which causes thermal heating of the media ~~in locations where the wavelengths are applied.~~

6-7. (cancelled)

8. (currently amended) The method according to Claim 1 wherein said recording step uses at least one an optical beam at least a portion of which represents said optical energy is redirected to said medium to carry out said providing exposing step.

9. (original) The method according to Claim 8 wherein said optical beam is a reference beam.

10. (currently amended) The method according to Claim 1 4 wherein said providing step comprises the step of directing said optical energy that has passed through said media from said recording of at least one of said one or more holograms to one or more locations on the media of one or more previously recorded holograms to fix the media against further recording at said one or more locations on the media where said optical energy is directed ~~reference beam used for fixing is passed through said media and redirected to said media for fixing said media in location other than locations which is recorded with said reference beam and fixed by said reference beam on being directed through said media at a location spaced from said recording location.~~

11. (currently amended) The method according to Claim 8 9 wherein said reference beam has a size more than that needed to record said at least one of said one or more holograms, and said optical energy is provided by part of said reference beam unused for recording said at least one of said one or more holograms to fix the media against further recording at said one or more locations of one or more previously recorded holograms ~~said exposing step is carried out on said medium in a fixing station separate from a holographic data storage system.~~

12. (currently amended) The method according to Claim 1 wherein said recording step uses a reference beam in recording said one or more holograms, and said providing step further comprises the step of directing optical energy of said reference beam that has passed through said media when said at least one of said one or more holograms is recorded to one or more locations on the media of one or more previously recorded holograms to fix the media against further recording at said one or more locations on the media where said optical energy is directed ~~exposing step is carried out by flooding said media with optical, thermal or other electromagnetic energy sufficient to fix said media after recording of holographic images thereon.~~

13. (currently amended) The method according to Claim 1 wherein said providing ~~exposing~~ step is carried out by the steps of:

collecting optical energy that passes through the media from said recording step for recording at least one of said one or more holograms; used for recording and

redirecting said collected optical energy to one or more locations on the media of one or more previously recorded holograms to fix the media against further recording at said one or more locations on the media where said collected optical energy is redirected ~~to a location on said media where fixing is carried out.~~

14. (currently amended) The method according to Claim 1 wherein said optical energy provided to the media to fix the media against further recording at said one or more locations on the media is ~~the exposing step is carried out by beams oriented, diffused or~~ has ~~having~~ coherency insufficient to record spurious holographic images.

15. (currently amended) The method according to Claim 13 wherein said providing step is further carried out by the steps of:

recollecting said redirected optical energy which again passes through said media;  
and

redirecting said ~~collected light said is~~ recollected optical energy to fix the media against further recording at said one or more locations on the media where said

~~recollected optical energy is redirected and passed through different locations of said medium on multiple passes thereby fixing a plurality of locations at the same time.~~

16. (currently amended) The method according to Claim 15 wherein said recollecting and redirecting steps are carried out one or more times using optical energy which passes through said media that was previously recollected and redirected ~~exposing step is carried out at locations simultaneously with new recording at another location in said media.~~

17. (currently amended) The method according to Claim 1 wherein said providing ~~exposing~~ step is carried out in multiple ones of said providing ~~exposing~~ step in order to sufficiently fix the media.

18. (currently amended) An apparatus for holographic data storage with ~~on a~~ photosensitive holographic data storage media which comprises:

means for recording one or more holograms representing ~~computer-readable~~ data at one or more locations on the media; and

means for providing optical energy from said recording means, while said recording means records at least one of said one or more holograms, to one or more locations on the media of one or more previously recorded holograms to fix the media against further recording at said one or more locations on the media where said optical energy is provided ~~operative after such recording for exposing the media with sufficient energy to fix the media against further recording in said locations, wherein said media is of photopolymer material.~~

19. (currently amended) The apparatus according to Claim 18 wherein said holographic media has a dynamic range capable of recording ~~accepting~~ a plurality ~~multiplicity~~ of holograms representing data in at least one location on said media ~~holographic images~~, said recording means is operative for recording over a portion of said dynamic range, and said providing ~~exposing~~ means is operative over the remainder of said dynamic range.

20. (currently amended) The apparatus according to Claim 18 wherein said recording means provides a reference beam and an object beam which overlap each other in said media to record said at least one of said one or more holograms, and said reference beam has a portion non-overlapping said object beam, and said non-overlapping portion provides said optical energy to fix the media against further recording at said one or more locations of said previously recorded holograms ~~said exposing means is operative to provide exposure energy over an energy range greater than that over which said recording means is operative.~~

21. (currently amended) The apparatus according to Claim 18 wherein ~~said exposing means~~ optical energy provided has ~~comprises an optical source providing~~ optical wavelengths that the holographic media is photosensitive to.

22. (currently amended) The apparatus according to Claim 18 wherein ~~said exposing means~~ optical energy provided has ~~comprises a source containing~~ wavelengths that the holographic media absorbs and which causes thermal heating of the media in ~~locations where the wavelengths are applied.~~

23-24. (cancelled)

25. (currently amended) The apparatus according to Claim 18 wherein ~~said recording means comprises means for providing at least one an optical beam in which at least a portion of said optical beam represents said optical energy, and said exposing means comprises means for redirecting said optical beam to said media.~~

26. (original) The apparatus according to Claim 25 wherein recording means is operative to provide said optical beam as a reference beam.

27. (currently amended) The apparatus according to Claim ~~18~~ 25 wherein said providing means comprises means for directing said optical energy from said recording means that has passed through said media, while said recording means records said at

least one of said one or more holograms, to one or more locations on the media of one or more previously recorded holograms to fix the media against further recording at said one or more locations on the media where said optical energy is directed ~~recording means is operative to use said reference beam for fixing, means for passing said reference beam through said media and redirecting said reference beam which is passed through said media for fixing said media in locations other than locations which are recorded with said reference beam and fixed by said reference beam on being directed through said media at a location spaced from said recording location.~~

28. (currently amended) The apparatus according to Claim ~~26~~ 18 wherein said reference beam has a size more than that needed to record said at least one of said one or more holograms, and said optical energy is provided by part of said reference beam unused for recording said at least one of said one or more holograms to fix the media against further recording at said one or more locations of one or more previously recorded holograms ~~said exposing means comprises means for flooding said media with optical, thermal or other electromagnetic energy sufficient to fix said media after recording of holographic images thereon.~~

29. (currently amended) The apparatus according to Claim 18 wherein said recording means uses a reference beam in recording said one or more holograms, and said providing means further comprises means for directing optical energy of said reference beam that has passed through said media when said recording means records said at least one of said one or more holograms to one or more locations on the media of one or more previously recorded holograms to fix the media against further recording at said one or more locations on the media where said optical energy is directed ~~holographic media has a dynamic range capable of accepting a multiplicity of holographic images, said recording means is operative for recording over a portion of said dynamic range, and said exposing means is operative over the remainder of said dynamic range.~~

30. (currently amended) The apparatus according to Claim 18 wherein said providing ~~exposing~~ means further comprises means for collecting and redirecting optical

energy that passes through the media from said recording means, while said recording means records at least one of said one or more holograms, to fix the media against further recording at said one or more locations on the media where said collected optical energy is redirected ~~is operative by collecting optical energy from said recording means and redirecting said energy to a location on said media where fixing is carried out.~~

31. (currently amended) The apparatus according to Claim 18 wherein said optical energy provided to the media to fix the media against further recording at said one or more locations on the media is said exposing means is operated by a beam oriented, diffused or has having coherency insufficient to record spurious holographic images.

32. (currently amended) The apparatus according to Claim 30 wherein said providing exposing means is operative by recollecting said redirected optical energy which again passes through said media and with redirecting said recollected collected optical energy to fix the media against further recording at said one or more locations on the media where said recollected optical energy is redirected ~~used for recording which is recollected and passed through different locations of said media on multiple passes thereby fixing a plurality of locations at the same time.~~

33. (currently amended) The apparatus according to Claim 32 wherein said providing means is further operative by repeating said recollecting and redirecting one or more times using optical energy which passes through said media that was previously recollected and redirected ~~18 wherein said exposing means is effective at locations which have been recorded simultaneously with recording at another location in said media.~~

34. (currently amended) The apparatus according to Claim 18 wherein said providing exposing means is operative by multiple exposures of said media in order to sufficiently fix the media.

35. (currently amended) An apparatus for fixing holographic data storage with on a photosensitive holographic data storage media having one or more locations of recorded

holograms, said apparatus comprising means for exposing the media with sufficient energy to fix the media against further recording in said one or more locations, wherein said exposing means is operative by directing optical energy for recording one or more holograms to at least one of said one or more locations on said media.

36. (currently amended) The apparatus according to Claim 35 wherein said optical energy is directed by said exposing means as radiation ~~is operated by a beam~~ oriented, diffused or having coherency insufficient to record spurious holographic images.

37-43. (cancelled)

44. (currently amended) The apparatus according to Claim 35 42 wherein said exposing means is operative by collecting optical energy from said recording means that passes through said media and redirecting said energy to a location on said media where fixing is carried out.

45. (cancelled)

46. (currently amended) A method of holographic data storage with ~~on~~ a photosensitive holographic data storage media which comprises the steps of recording one or more holograms representing data at one or more locations on the media, and after such recording exposing the media with sufficient energy to fix the media against further recording in said locations by collecting optical energy used for recording and redirecting said energy to at least one of said one or more locations on said media where fixing is carried out.

47. (currently amended) The method according to Claim 46 wherein said collected light is recollected and passed through different locations of said media ~~medium~~ on multiple passes thereby fixing a plurality of said locations at the same time.



48. (currently amended) An apparatus for holographic data storage with ~~on~~ a photosensitive holographic data storage media which comprises means for recording one or more holograms representing data at one or more locations on the media, and means operative after such recording for exposing the media with sufficient energy to fix the media against further recording in said one or more locations by collecting optical energy from said recording means and redirecting said energy to at least one of said locations on said media where fixing is carried out.

49. (currently amended) The apparatus according to Claim 48 wherein said exposing means is capable of fixing a plurality of said locations on said media at the same time.

50. (new) The method according to Claim 1 wherein said providing step and said recording step are carried out in the same housing.

51. (new) The method according to Claim 1 wherein said optical energy utilized by said providing step represents radiation which is not Bragg matched to any of the previously recorded holograms at the one or more locations being fixed by said providing step.

52. (new) The method according to Claim 1 wherein said media comprises photopolymerizable material.

53. (new) The method according to Claim 1 wherein said one or more previously recorded holograms were previously recorded by said recording step.

54. (new) The method according to Claim 12 wherein said directed optical energy of said reference beam that has passed through said media represents a beam having a coherence length reduced from that of the reference beam used in said recording step.

55. (new) The method according to Claim 12 wherein said step of directing optical energy of said reference beam that has passed through said media is carried out with the aid of a reflective surface.

56. (new) The method according to Claim 12 wherein said step of directing optical energy of said reference beam that has passed through said media is carried out utilizes a single reflective surface when the optical energy of said reference beam that has passed through said media is sufficient to fix the media.

57. (new) The method according to Claim 15 wherein said steps of collecting and directing said collected optical energy of said reference beam that has passed through said media are carried out with the aid of a first reflective surface disposed along one side of said media, and said steps of recollecting and redirecting said recollected optical energy are carried with the aid of a second reflective surface disposed on the opposite side of said media.

58. (new) The apparatus according to Claim 18 further comprises a housing having at least said providing means and said recording means.

59. (new) The apparatus according to Claim 18 wherein said media comprises photopolymerizable material.

60. (new) The apparatus according to Claim 18 wherein said one or more previously recorded holograms were previously recorded by said recording means.

61. (new) The apparatus according to Claim 29 wherein said directed optical energy of said reference beam that has passed through said media is not Bragg matched to any of the previously recorded holograms in the one or more locations being fixed by said optical energy.

62. (new) The apparatus according to Claim 29 wherein said directing means further comprises a diffuser, wherein said directed optical energy of said reference beam that has passed through said media represents a beam having a coherence length reduced by said diffuser.

63. (new) The apparatus according to Claim 29 wherein said directing means comprises a reflective surface.

64. (new) The apparatus according to Claim 29 wherein said directing means further comprises:

- a first reflective surface disposed along one side of said media to redirect said reference beam to fix said media at at least one of said one or more locations; and

- a second reflective surface disposed on the opposite side of said media that redirects said reference beam which passed through said media to fix said media at one or more other of said one or more locations.

65. (new) A system for holographic data storage on holographic data storage media comprising:

- an optical source;

- optics for recording one or more holograms on media; and

- optics for fixing the media from further recording where said one or more holograms were recorded, wherein said optics for recording and said optics for fixing are operative using radiation from the same said optical source.

66. (new) The system according to Claim 65 further comprising a housing having at least said optical source, said optics for recording, and said optics for fixing.

67. (new) The system according to Claim 65 wherein said optics for fixing comprises a reflective surface for redirecting light that passes through the media during recording for fixing the media where said one or more holograms were previously recorded.

68. (new) The system according to Claim 67 wherein said reflective surface is one of a flat, aspheric, or spherical mirror.

69. (new) The system according to Claim 65 wherein said optics for recording directs a reference beam having a cross-sectional size more than that needed for recording a new hologram at a location in the media, and said optics for fixing is provided by said optics for recording in which a part of said reference beam unused for recording is directed by said optics for recording along with the reference beam for recording said new hologram to another location on the media to fix said another location from further recording.

70. (new) An apparatus for holographic data storage with a photosensitive holographic data storage media comprising:

at least one beam of optical energy directing to said media; and  
optics having at least a reflective surface which redirects optical energy of said beam which passes through the media to at least one location on said media having one or more recorded holograms to fix said location from further recording any hologram at said location.

71. (new) The apparatus according to Claim 70 further comprising means for recording one or more holograms in said media, and said recording means provides said beam.

72. (new) The apparatus according to Claim 70 further comprising a source providing said optical energy for said beam.

73. (new) The apparatus according to Claim 72 further comprising means for recording holograms in said media, in which said source is not part of said recording means.

74. (new) An apparatus for holographic data storage with a photosensitive holographic data storage media which comprises:

means for recording one or more holograms representing data at one or more locations on the media; and

means for exposing the media with sufficient energy to fix the media against further recording in said one or more locations, in which the exposing means comprises one or more LED sources providing radiation that when applied to said media at the one or more locations of the media is capable of fixing the media from further recording at said one or more locations.

75. (new) An apparatus utilizing holographic data storage comprising:

a source providing a beam; and

optics for redirecting said beam that passes through the media to one or more locations in the media where one or more holograms have been previously recorded.

76. (new) The apparatus according to Claim 75 wherein said optics represents first optics, and said apparatus further comprises second optics utilizing said beam for recording one or more holograms in the media.

77. (new) The apparatus according to Claim 75 wherein said source represents a first source, and said apparatus further comprises a second source providing another beam capable of being used to record one or more holograms.